Bifurcated endovascular graft insertion for abdominal aortic aneurysm

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Patient selection

All these procedures are currently performed as part of clinical trials, which adhere to rigid selection criteria. Only patients who would normally be candidates for conventional repair are included. High risk patients and those with small aneurysms are specifically excluded. All patients who satisfy the (CT) computerized tomography and clinical criteria for inclusion in the study have multi-plane arteriography with intra-aortic injection of contrast to assess aortic and iliac arterial anatomy. Anatomic exclusion criteria are: 1. Proximal neck shorter than 20 mm; 2. Iliac artery diameter wider than 20 mm; 3. Iliac artery stenosis with diameter of less than 6 mm; 4. Signs that the inferior mesenteric artery (IMA) is indispensable. These include angiographic visualization of a large IMA, filling of superior mesenteric artery (SMA) via collaterals, stenosis of coeliac or SMA on oblique views.

An additional requirement for insertion of a straight graft is the presence of a distal cuff longer than 15 mm. The rarity of this anatomic feature excludes the vast majority of patients from straight graft repair. Indeed, we have yet to perform a straight graft insertion.

General points

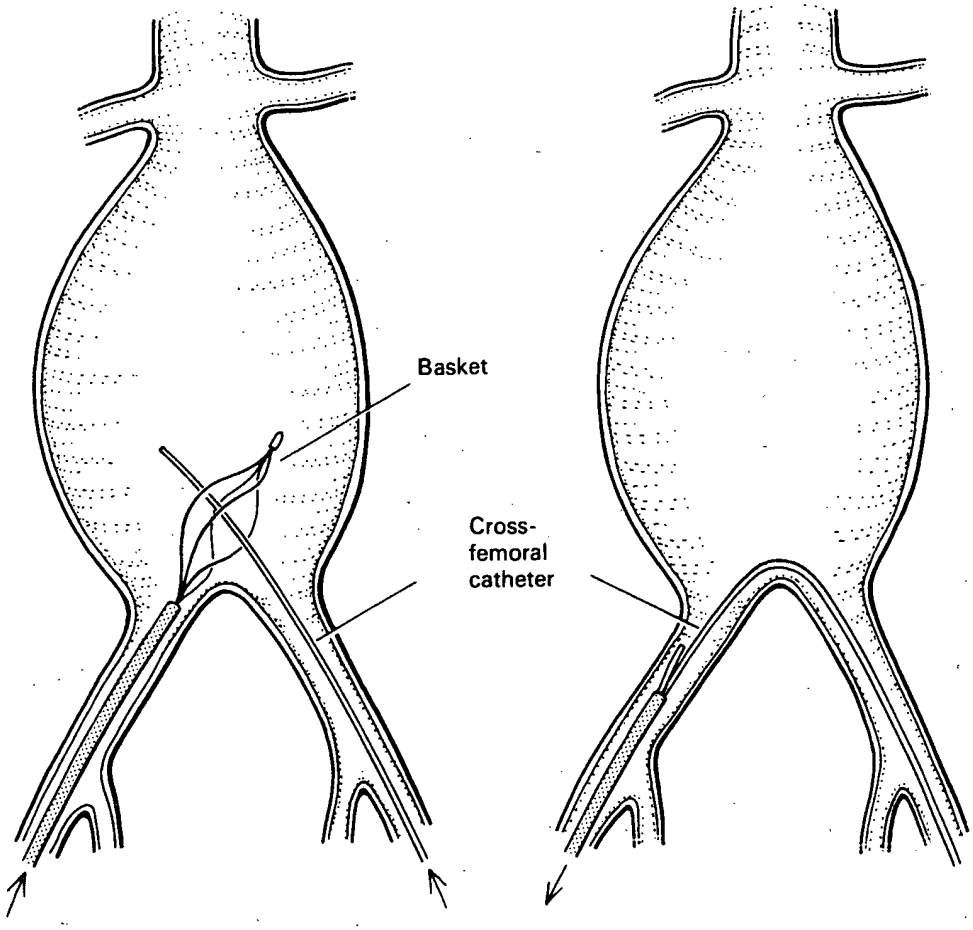
The procedure is performed in the operating room under local anaesthesia, with an anaesthesiologist in attendance. The patient is positioned on a radiolucent operating table to permit fluoroscopic examination of the entire abdomen and groins. A radioopaque ruler under the patient provides a useful frame of reference for fluoroscopy. A high resolution digital imaging system is required to guide placement. Desirable features of the imaging system include last image hold, digital subtraction, roadmapping and hard copy output. Grafts may be inserted from either femoral artery. The main factor that determines the side of insertion is tortuosity or stenosis of the iliac arteries on preoperative angiography.

Bifurcated graft insertion

The lower chest, abdomen and both groins are prepared and draped in the usual sterile fashion. Both common femoral arteries are exposed and dissected free from surrounding structures using standard surgical techniques. A soft, disease free portion of the anterior common femoral artery is selected for arteriotomy on each side. Double looped tapes are used to encircle the common femoral (or distal external iliac artery) at two points proximal to the site of the arteriotomy. Heparin (100 units/kg) is administered by intravenous injection 3 minutes prior to tightening the loops proximally and applying non-crushing vascular clamps distally. A short transverse femoral arteriotomy is used as a means of access to the distal arterial tree on each side. A slightly larger aperture is needed on the side selected for insertion of the delivery system. Following femoral arteriotomy, the steps in bifurcated graft insertion are as follows:

1

Placement of a cross-femoral catheter, using a stone retrieval basket. A guidewire is passed, under fluoroscopic guidance, up the iliac arteries into the aneurysm. A sheath is then inserted over the guidewire. The guidewire is then replaced with a stone retrieval basket. The basket is opened in the aneurysm and pulled back to the orifice of the iliac artery. The cross-femoral catheter is passed over a second guidewire up the contralateral iliac artery into the waiting basket, which is closed and withdrawn. This occasionally requires preliminary manipulation of the guidewire into the basket using curved (visceral) angiographic catheters.



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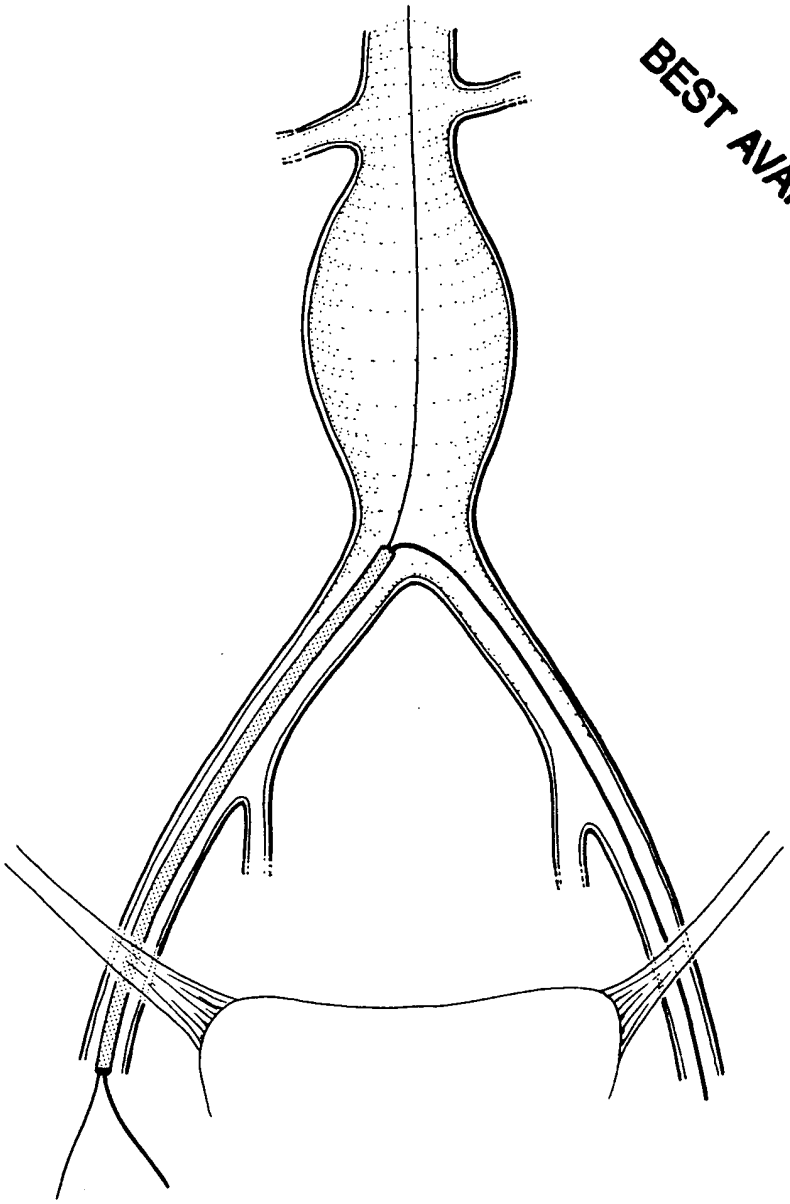

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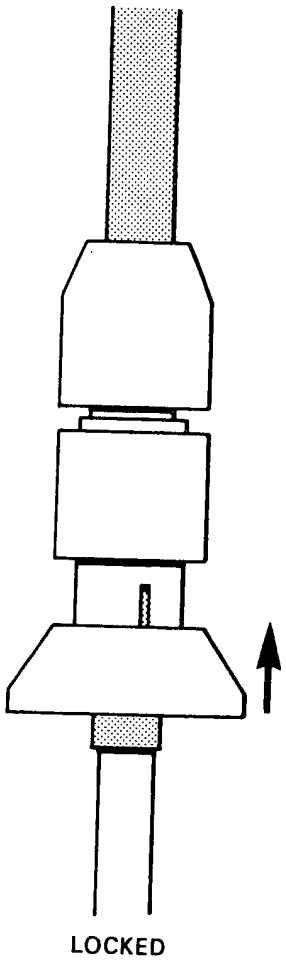
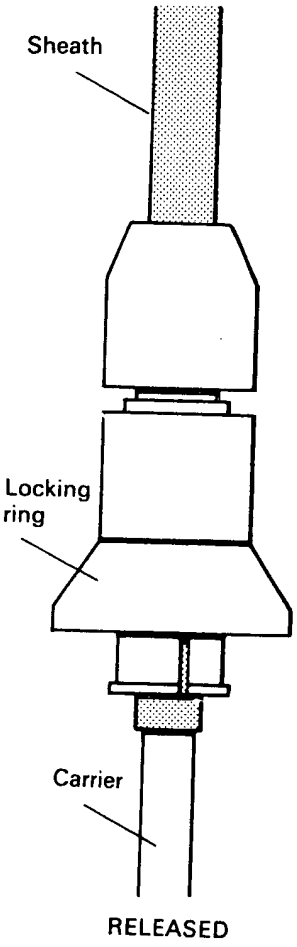
2

A double lumen catheter is used to separate the cross-femoral catheter from an angiographic guidewire. This prevents twisting of the catheter and the guidewire, that would later be reflected as twisting of the graft limbs. An angiographic catheter is inserted over the guidewire.

Aortography is used to locate the renal and iliac arteries. These are marked on the video screen, together with markings of the ruler, as a guide to stent/graft placement. Alternatively the angiogram can be stored as a 'road map', to be superimposed on subsequent fluoroscopy. Whatever technique is used, correct positioning of the prosthesis depends on a constant relationship between the imaging system and the patient. If it is necessary to move either the C-arm or the patient, their relative positions can be restored by reference to the markings of the ruler.

The angiographic catheter is exchanged for the delivery system over a stiff guidewire. Markings on the delivery system are used to ensure proper orientation of the graft. The delivery system can be rolled back and forth a little to facilitate introduction, but it should not be rotated continually in the same direction. The delivery system is advanced to bring the proximal stent to its desired location.





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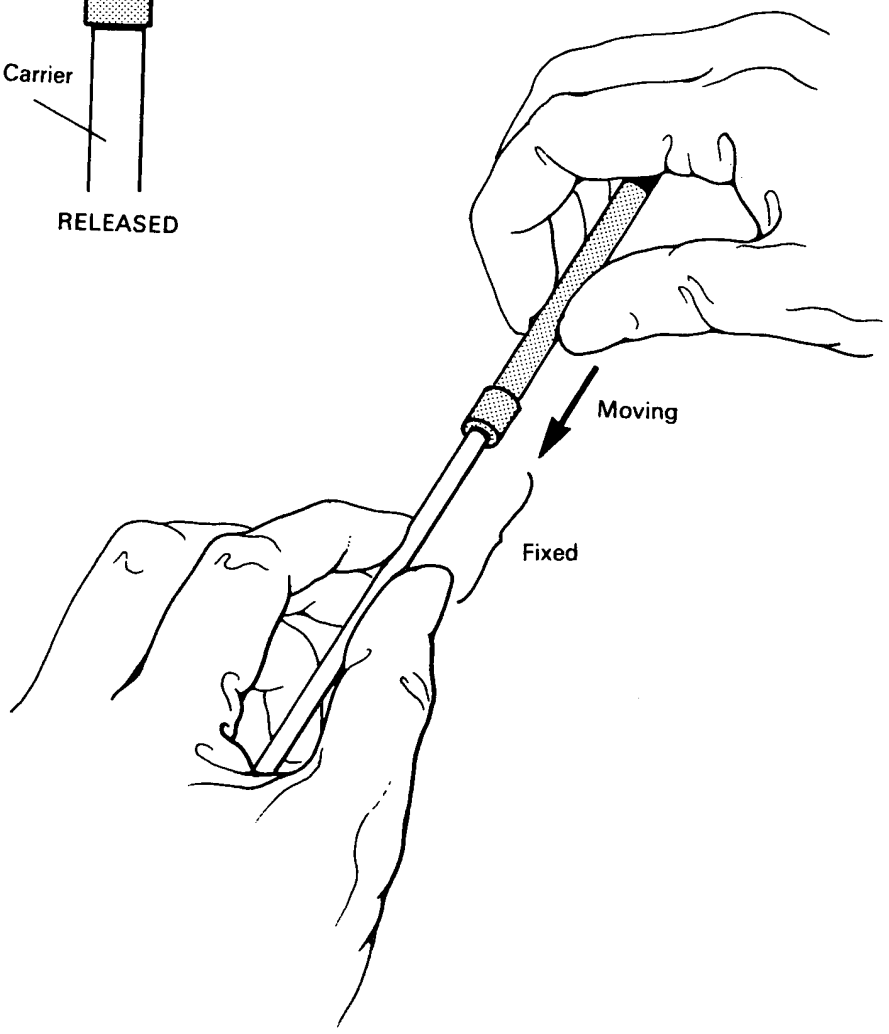
3 & 4

The outer sheath of the delivery system is released from the central carrier by advancing the locking ring towards the cranial end of the device (*Illustration 3*).

The graft is extruded by withdrawing the sheath slowly over the carrier. The position of the graft is maintained during graft extrusion by manipulation of the central carrier. Precise control is enhanced by bracing the carrier against the patient's thigh with one hand while the other pulls back the sheath (*Illustration 4*).



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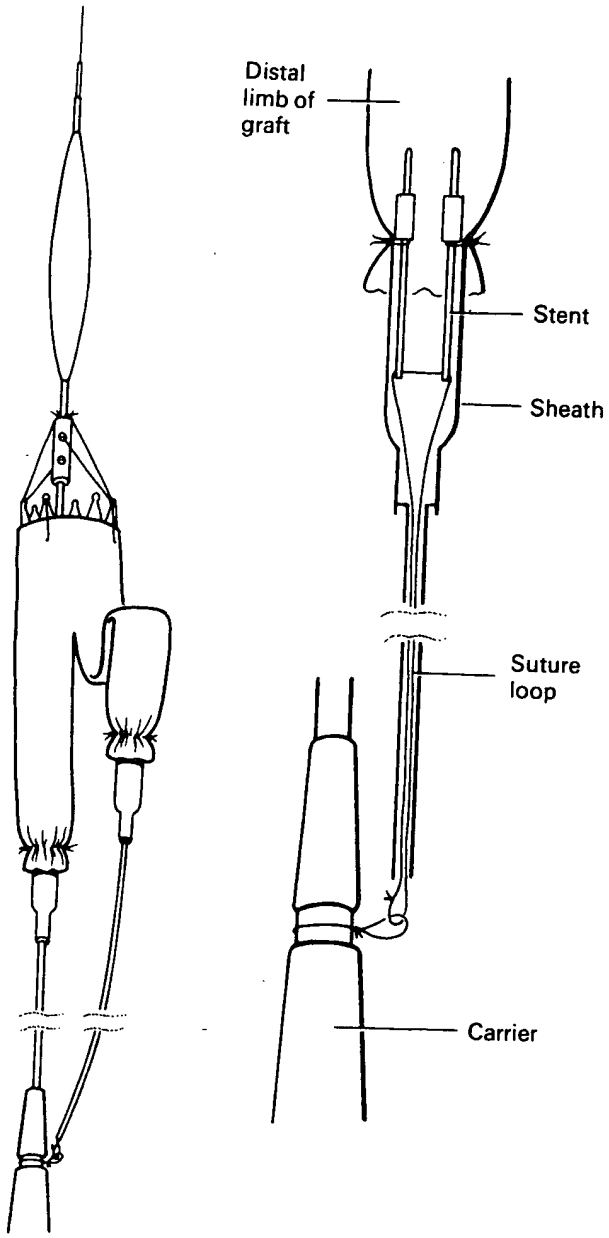
5 & 6

The small catheter, that extends from the graft limb alongside the carrier (*Illustration 5*), is sutured to the cross-femoral catheter (*Illustration 6*). Placement of sutures in the cross-femoral catheter is after the fashion of a tendon repair.



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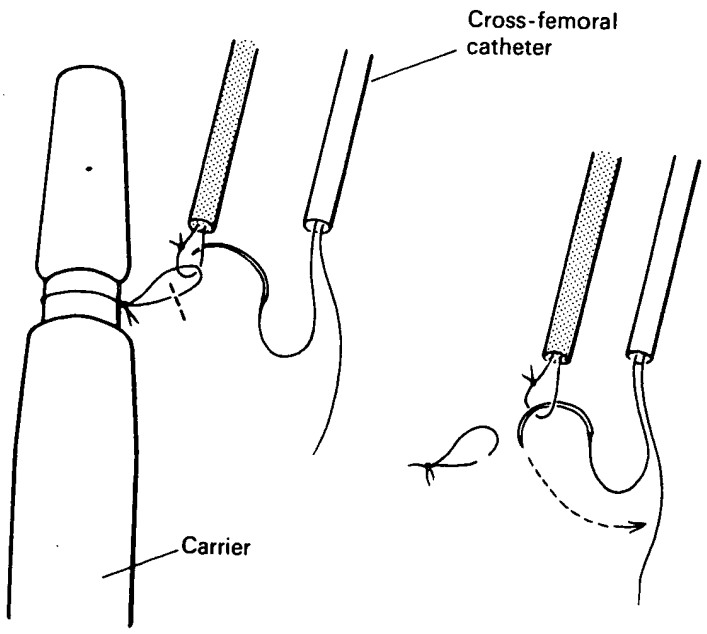

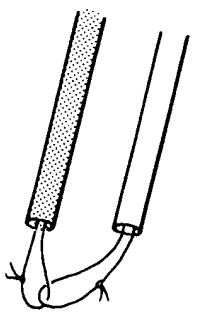

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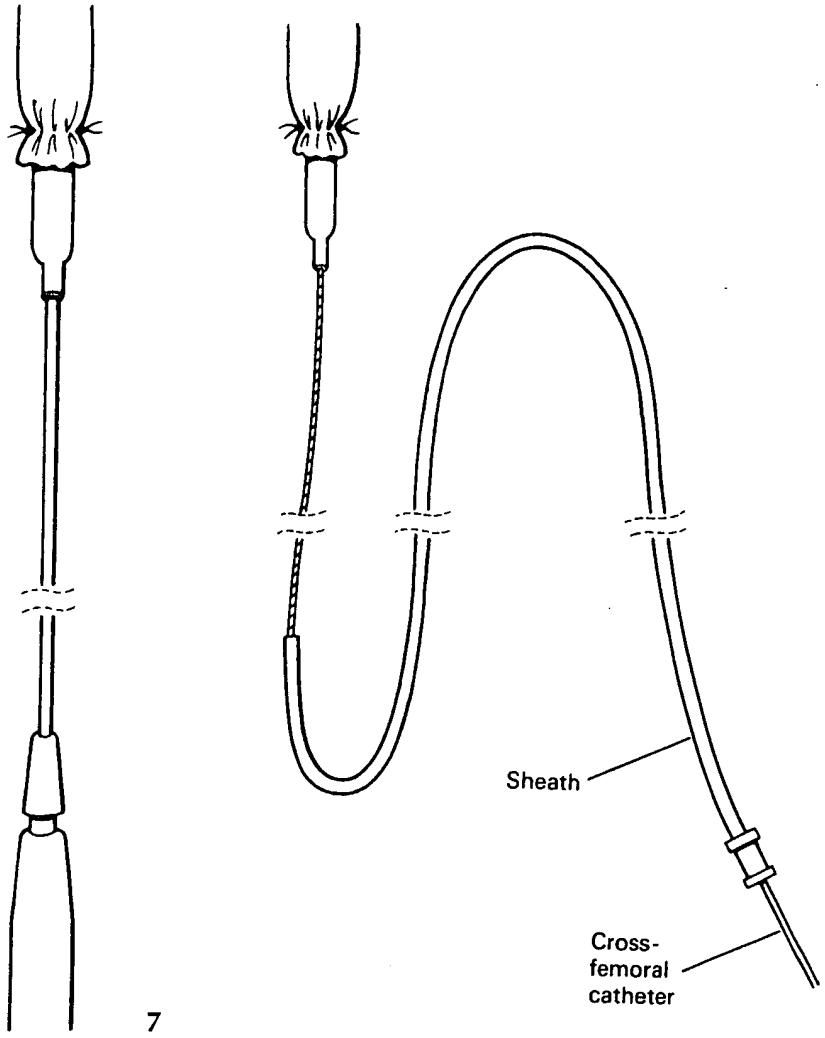

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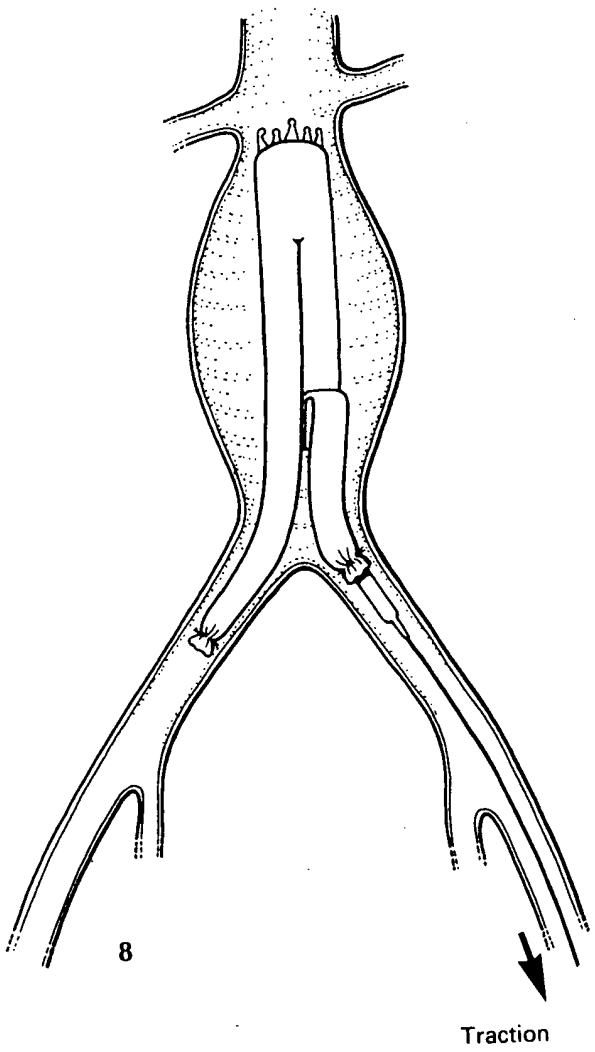
A sheath is advanced over the cross-femoral catheter onto the small catheter, thereby covering the sutured joint.

8

Traction on the cross-femoral catheter pulls the graft limb into position.



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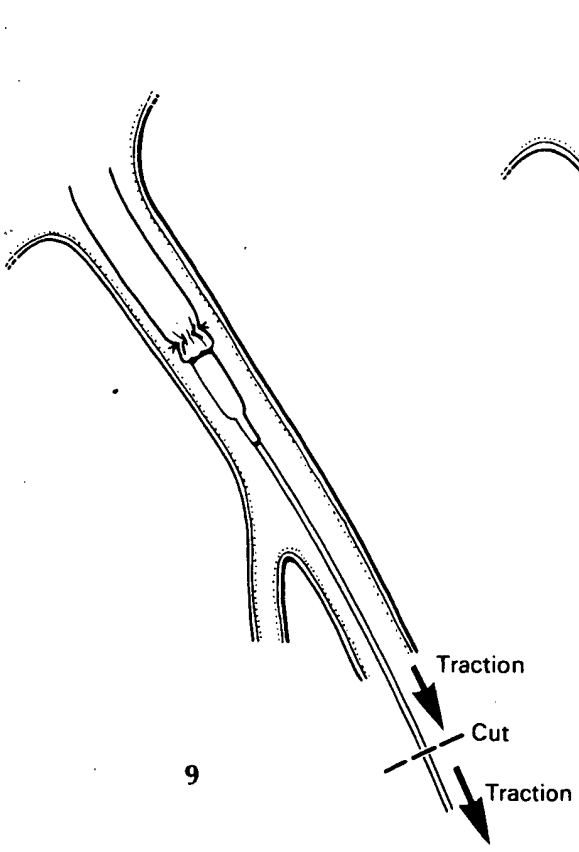
9

The small catheter is cut while under a little tension. This also cuts the suture within and releases the distal stent.

The haemostatic bands around the femoral artery must be relaxed a little to permit the atraumatic removal of the small sheath and attached catheter. When this has been done two cut ends of suture protrude from the arteriotomy. These are still looped around the stent. They can remain, as a means of manipulating that graft limb, until the procedure is complete.



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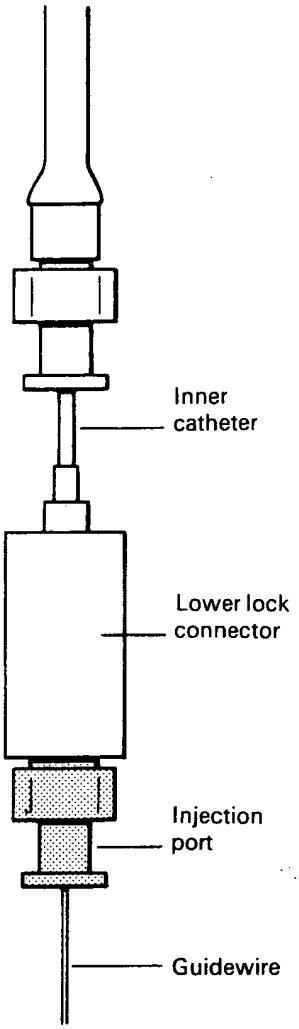
Release of a Luer® lock mechanism permits removal of the inner catheter, which detaches the graft from the delivery system. Removal of the delivery is accompanied by removal of the last distal stent sheath and expansion of the third stent. The guidewire is reinserted before the tip of the delivery system is entirely out of the graft to facilitate replacement of the angiographic catheter.

Completion angiograms are obtained mainly to check for renal artery flow. High resolution digital subtraction systems will also provide angiographic information on any flow limiting kinks or twists in the graft limbs and possible perigraft leakage. Both femoral arteries are flushed to remove particulate matter. The femoral arteriotomies and the wounds are closed in the standard fashion.



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Follow-up

The patients are followed by serial colour flow duplex ultrasound examinations and abdominal radiographs. In some institutions we also perform postoperative magnetic resonance angiograms and three-dimensionally reconstructed spiral CT scans.